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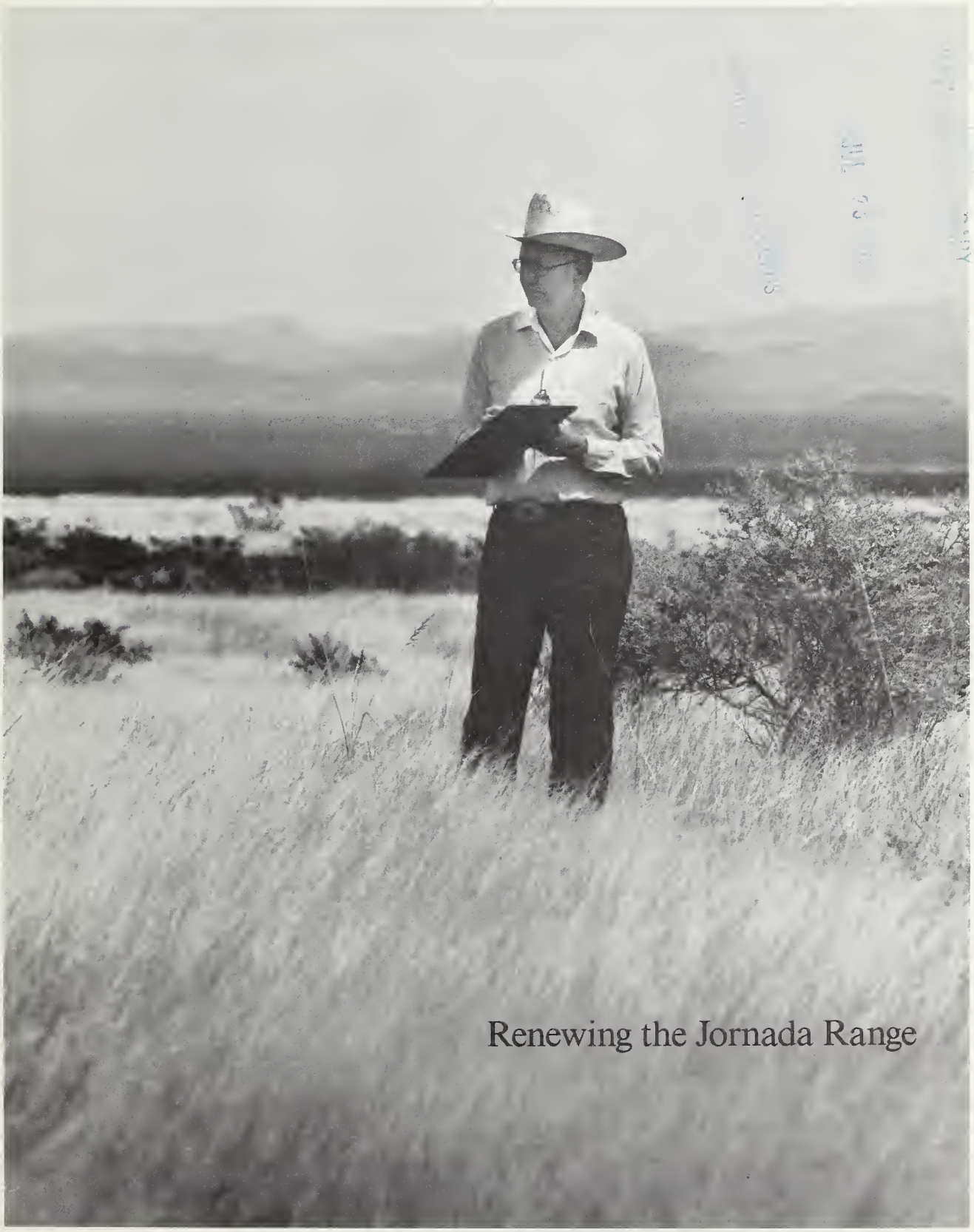
Agricultural Research



Renewing the Jornada Range

What Will Bring The Grass Back?

More than 400 million acres of rangeland are in fair to poor condition today, caused by ill-timed or excessive grazing in the late 1800's and early 1900's. In those days of ranching in the southwestern states, for example, one cow could live a year on grass produced by about 60 acres. Now it takes from 200 to as many as 600 in the hardest hit areas.

The long-term effect on the harsh ecology of the western grasslands was not recognized for many years. Ranchers for a time believed the grass would recover with the next good rain and all would be well. But this proved to be false. Grass that had been grazed too much at the wrong time couldn't produce enough nutrients to survive. As the grass weakened and died, brush and other undesirable plants replaced it. The deterioration peaked around 1889, after a 2-year drought that killed many acres of already weakened grasslands.

By the turn of the century, people began to ask the questions they should have asked long before. How do we increase herds without damaging forage plants? How do we manage herds to cope with droughts? How do we restore depleted range—or can we?

In 1904, E.O. Wooton, a farsighted botanist with the U.S. Department of Agriculture, began the first scientific search for answers, on rangeland in southern New Mexico. Largely through his efforts, public land was set aside in 1912 for USDA to administer as the Jornada Experimental Range.

The area that is now the Jornada began as a textbook example of good rangeland gone wrong, an example applicable in principle to all rangeland. Its most important—and sobering—lesson since its inception comes from the fact that it took almost 60 years of careful management to bring a part of the Jornada back to a high-quality condition. Of course, restoration could have been done in less time, but that would have required expensive treatments which from a rancher's standpoint would be impractical.

The science of rangeland management has its roots in places like the Jornada and in the general concern that led to its formation.

USDA has taken a leading role in shaping rangeland science's relatively brief history. The science of range management didn't really get into full swing until about 50 years ago. Looking forward to the next 50 years, the Department faces the continuing challenge of preserving the land and its ecosystems while working to maintain a productive resource on the nation's nearly 1 billion acres of grazing land.

Mindful of the time that it took to restore the Jornada, ARS will place a strong emphasis on long-term, basic research. This research will develop new understanding of how plants and animals interact in rangeland situations that vary from the desert grasslands of the southwest to the bunchgrass steppes of the Palouse in the Pacific Northwest.

From this understanding will come new solutions to problems that continue to plague ranchers:

- Development of computer models such as SPUR (Simulation of Production and Utilization of Rangeland) that can predict the consequences of grazing, weather, wildlife, and many other variables on the range environment.
- Introduction of grasses that produce more livestock feed and are better able to compete with less desirable plants. Kleingrass from Africa produces up to 50 percent more feed in the arid southwest.
- Continuation of traditional breeding programs for forage plants that are more nutritious and higher yielding. Several traditionally bred forage grasses have been released in recent years.
- Genetic alteration of grasses to create varieties not possible with traditional breeding. Johnstone Tall Fescue is a recent success, combining the superior digestibility of ryegrass with the hardiness of fescue. Another creation is Hycrest, a crested wheatgrass and quackgrass hybrid that is drought-resistant and has a 25-percent higher yield.
- Biological control of undesirable weed species, probably the most affordable way to reclaim vast expanses of western rangeland. The philosophy behind this research is to weaken weeds with a group of insects and parasites that together attack several parts of the weed, from seeds to roots to leaves and stems. Although most successes are limited to the laboratory so far, scientists are searching for insects, fungi, and nematodes to control leafy spurge, yellow star thistle, knapweeds, and other weeds.

This approach to biological control research, like the overall range and pasture research program it is part of, is based on understanding the fundamental ecological processes. After all, the most economically efficient way to restore rangeland is to use the dynamic processes of its ecosystems to balance grazing livestock, native grazers, and the environment. Such ecosystems will be able to function self-sufficiently, without the added expenses of pesticides, fertilizers, or annual reseeding.

Gary R. Evans, ARS National Program Leader for Range and Pasture.

Agricultural Research

Cover: Range scientist Carlton Herbel inspects Lehmann lovegrass on the 190,000-acre Jornada Experimental Range in New Mexico where ARS researchers are removing invading brush and shrubs and replacing them with native and introduced forage grasses. Story begins on page 6. (0586X588-28)

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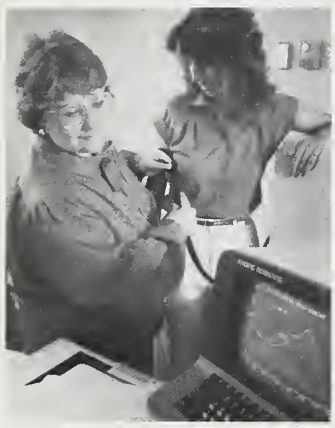

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Milk for the Mature Majority

The majority of the world's people avoid the best dietary source of calcium, vitamin D, and high-quality protein because a glass of milk can bring on stomach cramps, diarrhea, and other problems.

By the age of 20, more than half of the people worldwide stop producing enough of the enzyme needed to digest lactose, the primary sugar in milk, says Agricultural Research Service food technologist Frank E. McDonough at the Beltsville Human Nutrition Research Center.

But McDonough has developed a method that allows lactose-intolerant people to have their milk and digest it too. His study shows that these people can avoid the discomforts associated with ordinary milk by eating yogurt—a fermented milk product—or by drinking sweet acidophilus milk prepared in a special way.

Both products, he says, contain bacteria that produce the missing enzyme, lactase. During the fermentation of yogurt, the bacteria digest a portion of the lactose sugar for their own use. Then, when the yogurt is eaten, these bacteria are digested in the gut, releasing enough of the enzyme to split the remaining lactose molecules into absorbable pieces.

All 14 lactose-intolerant people who participated in the study showed a marked improvement in digestion of yogurt over plain milk, he says.

Commercial sweet acidophilus milk, on the other hand, is prepared by adding bacteria to cold milk, and no fermentation takes place. When the product is consumed, the bacteria remain intact, keeping the enzyme locked up, he says.

To solve this problem, McDonough uses high-frequency sound waves to rupture *Lactobacillus acidophilus* bacteria before adding them to the cold milk. The result: five of the seven lactose-intolerant people who consumed the specially prepared milk digested it easily.

"They could drink at least one cup of the milk per meal, two to three times a day, without any problem," he says.

McDonough is investigating the feasibility of patenting the sound-wave treatment for USDA.—By **Judy McBride,** ARS.

Frank E. McDonough is at the USDA-ARS Energy and Protein Nutrition Laboratory, Rm. 205, Bldg. 157, Beltsville Agricultural Research Center-West, Beltsville, MD 20705. ■

Purplestraw Wheat Makes a Half Million

A major milestone in managing the nation's plant gene resources has been reached with the entry of the 500,000th plant introduction into the National Plant Germplasm System.

The national system is a cooperative program among private, state, federal, and international agencies to maintain information on live plant materials in the United States. It contains descriptions of the genetic characteristics, country of origin, storage location, plus other information.

Plant introduction numbers date back 88 years to a cabbage variety brought in from Russia, says Agricultural Research Service Plant Introduction Officer George A. White. The milestone PI is a purplestraw wheat which has served as valuable parent material for several other wheat varieties as well as being commercially grown in the Southeast.

"Each plant introduction represents a different source of genetic diversity," says White. With the information contained in the computer database of the National Plant Germplasm System, it is easy for research scientists to locate combinations of plant genes that may lead to crops that can better cope with diseases and insect pests, harsh climates, or poor soils.

Plants and seeds to be entered into the national germplasm program are sent to the ARS Germplasm Introduction and Evaluation Laboratory at Beltsville, MD—the first stop in the network of 45 locations responsible for evaluating, documenting, maintaining, and distributing plant germplasm.

The Plant Introduction Office acts as a focal point, working closely with private, state, federal, and international agencies, to exchange germplasm throughout the world. In 1985, over 95,000 items of plant material were sent to 123 countries.—By **Deborah Aksler,** ARS.

George A. White is in the USDA-ARS Plant Introduction Office, Beltsville Agricultural Research Center-West, Beltsville, MD 20705. ■

Weight-Control Enzyme

Could pigs, the archetypical heavyweights, one day help free people from obesity? Perhaps. New ways to predict obesity in pigs may lead to slimmer people as well as leaner pigs, according to Gary J. Hausman, an animal physiologist with the Agricultural Research Service in Athens, GA.

Hausman and ARS animal physiologist Dennis R. Campion—working with Roy J. Martin, professor of Human Foods and Nutrition at the University of Georgia—made a discovery when they compared blood and tissue samples from fetuses of genetically fat and lean pigs: All the fetuses of the fat pigs had lower levels of a swine growth hormone coupled with higher amounts of a key enzyme in their blood.

Scientists knew this was true of adult pigs but had not known it to be so for fetuses.

The enzyme lipoprotein lipase (LPL) acts as a gatekeeper, waiting

on the wall of blood vessels to break down large fat molecules, allowing the fatty acids to pass through the wall into fat cells. The more LPL available, the more fat deposited in the body.

The swine growth hormone frees fat from storage, letting it be used to build muscle or other tissue. Depressed levels of the hormone mean more fat is stored, making for fatter pigs.

Knowing that the hormone and enzyme levels genetically associated with obesity can be found in the fetus means that genetic fatness in adult pigs can be predicted.

Perhaps the most immediate benefit of this research will be diagnostic tools to select genetically lean pigs for breeding.

But Hausman believes that it may be possible to extrapolate these results to people. As research models, pigs are closer to people than most other laboratory animals. The similarity of the digestive, nervous, and immune systems has been a boon to researchers studying human diseases. Obese people are known to have excessive LPL of a type that closely resembles that of pigs. The swine growth hormone indicator of fatness may also have a counterpart in people.

If so, a simple blood test of infants would allow doctors to tell if children are predisposed to being fat. Parents could then work with nutritionists to plan special diets for their children.

Even more important, this research could be a first step toward food supplements that counteract the genetic tendency to obesity in people and pigs.

Along those lines, Hausman and his colleagues are testing the effects of hormones and other substances on the development of fat cells in laboratory cultures.—By **Don Comis** and **Vince Mazzola,** ARS.

Gary J. Hausman is at the USDA-ARS Animal Physiology Research Laboratory, Richard B. Russell Research Center, Athens, GA 30613. ■

Natural Control of Pecan Pest

Field tests in Georgia pecan groves have demonstrated that partly substituting natural pest control for pesticides could create considerable savings for U.S. pecan growers.

Georgia produced nearly half of the $160 million U.S. pecan crop last year.

W. Louis Tedders, an Agricultural Research Service entomologist at Byron, GA, successfully used both lacewings and ladybugs against pecan aphids and mites in several years of tests.

For ladybugs, Tedders uses the convergent lady beetle *(Hippodamia convergens).* It readily feeds on pecan pests even in 70- to 100-foot-high trees. [*For more on biological control, see "Battle Plans for National Assault on Aphids," page 10*—**Ed.**]

To encourage proliferation of lacewings and ladybugs, Tedders had a cooperating pecan grower plant vetch and arrowleaf clover among the trees in his 1,700 acres of orchard. Lacewings and ladybugs eat pea aphids, and pea aphids thrive on vetch and clover. The predators flourished and saved thousands of dollars in pesticide costs during the first half of the 1985 growing season. The appearance of other pest species midway through the season prompted the grower to apply pesticides. Tedders persuaded him to leave 30 acres alone, for comparison.

Interestingly, Tedders found that insect damage in the unsprayed 30 acres was no worse than that in the sprayed area. "He would have been better off not spraying at all that season," Tedders says.

However, because the ladybugs and lacewings are themselves subject to predation and disease, it is not likely that growers could maintain high enough populations year after year to ensure adequate protection of the crop without pesticides.

Near Albany, GA, cooperating farm manager Buddy Reese examines pecan trees for pecan aphids and the lady beetle *H. convergens.* (0586X595-21A)

Tedders is looking at a rotation plan that would combine both natural controls and pesticides. He will be determining if it is possible to use beneficial insects up to the point when natural factors reduce their numbers. Then pesticides would be used, either to control the predators, parasites, and diseases of the beneficial insects or to directly control the pecan pests. Such a rotation might involve spraying only every other season.—By **Linda Anzelmo** and **Don Comis,** ARS.

W. Louis Tedders is at the USDA-ARS Southeastern Fruit and Tree Nut Research Laboratory, P.O. Box 87, Byron, GA 31008. ■

Jornada Experimental Range:

Fifty years ago, much of the rangeland of the Southwest, including the Jornada, had been taken over by brush. Because of economic and social changes, this labor-intensive method of clearing brush for replanting to grass is no longer feasible. (333012 RM-Research; photo courtesy National Agricultural Library, Forest Service Collection)

With little-known names like black gramma and mesa dropseed, their passing would not be noticed by many people. But as these grasses and others lose in the perennial battle for growing space on southwestern ranges, so do ranchers whose cattle and sheep depend on them for food.

Early ranching and farming practices, and normal droughts inflicted by nature, changed many grasslands to brushlands in Arizona, New Mexico, and Texas. Woody plants, once restricted mainly to waterways and natural drainage areas, now form an almost continuous cover over millions of acres of former grasslands.

Invasion by these poor-quality plants drastically cuts the number of grazing animals an area can support. The range condition of many areas in the arid Southwest is so low today that each cow needs grass from 200 to 600 acres of rangeland to survive for a year. Late in the past century, some ranchers were using only 60 acres per cow per year.

"The introduction of cattle to the area in the 1880's contributed to the vegetative change from grasslands to shrublands. Overgrazing, coupled with periodic droughts, slowly changed ranges totaling perhaps 100 million acres," says Agricultural Research Service range scientist Carlton H. Herbel, Las Cruces, NM.

When grasses are grazed too close to the ground, it is easier for drought to kill them. Proper grazing—carefully matching the correct number of cattle to the amount of forage—reduces this hazard.

Another factor contributing to the spread of brush is cattle swallowing whole seeds. These seeds can pass through their bodies without being affected by digestive juices. When animals, including wild species, defecate, brush seeds are dispersed on land that was brush-free. These seeds are in an ideal growing medium—the manure provides them both moisture and nutrients.

Farmers contributed to this decline by plowing under native grasses so they could plant small grains such as oats and wheat. These new crops survived when the rains came, but droughts eventually drove the farmers out of business.

Seeding to restore these ranges is difficult and often uneconomical. Native grasses, and many of those brought from foreign countries, just don't produce seed that is equipped to sprout efficiently and grow on the area's limited rainfall. Woody plants now cover these abandoned fields.

In the 1930's, the Civilian Conservation Corps enclosed about 2,000 acres of New Mexico rangeland with a fence that would keep out all grazing animals, including wildlife. The area, located on the 190,000-acre Jornada Experimental Range near Las Cruces, NM, still shows a surprising change from grass to brush, thus demonstrating

We're Still Learning

"Bonded" sheep and beef cattle on the Jornada Experimental Range. Cloth tape encircling the animals' bodies show their bonding groups for long-distance identification. (0586X574-13)

the ability of brush to continue to invade damaged grasslands even without livestock grazing.

Some people had thought the ranges would recover on their own.

"We can trace vegetative changes on the Jornada because surveyors for the U.S. government carefully recorded types and densities of plants when they crossed this area in 1858. Range scientists have made periodic inventories since then," says Herbel.

The inventories paint a graphic picture of brush replacing grass. Of the 144,475 acres surveyed in 1858, 90 percent were covered with grass. By 1915, dense brush—mainly mesquite—had invaded a quarter of the land. By 1963, only a quarter of the land still had good grass cover and almost none remained brushfree.

Carefully regulating the number of animals is necessary to prevent further degradation. Calculating the proper number of cattle for each range is still pretty difficult. Ranchers can't predict the amount of precipitation their land will receive in the future. This makes it difficult to plan herd size and marketing strategy.

"With social bonding and specially trained guard dogs, we may be able to protect our sheep without building expensive fences."

—Clarence V. Hulet.

"We can improve these ranges, but it won't be cheap or easy," says Herbel, who works at the Jornada. "And it may require decades to make any real progress."

To improve them, it is necessary to chemically or physically remove the woody plants and replace them with more nutritious grasses, says Herbel.

He and fellow ARS scientists on the Jornada have developed techniques to reduce brush and shrubs and make way for native and introduced grass species.

One way is to ride horseback, applying herbicides to individual plants. In badly infested areas, hiring commercial aerial applicators to spray may be more practical.

Social Behavior on the Range

Sheep and cattle normally segregate when grazing the same range. The sheep stay together at one end of the range while the cattle eat at the other. Later, they change territories, each eating its favorite kind of forage.

However, by bringing the two animal species together when the lambs are very young, it is possible to form a close social bond in which lambs develop an impelling need to be close to

Tissue culture of four-wing saltbush, a range plant native to much of the western United States, is examined by geneticist Jerry Barrow. Lab cloning may lead to faster development of stress-tolerant plant varieties that are suited to livestock forage and forage and cover for wildlife. (0586X569-19)

cattle as they move about on the open range.

Scientists at the Jornada Experimental Range hope that this kind of bonding will cut lamb losses from predators. Cattle intensely dislike coyotes and strange dogs, and it is reasoned that if cattle and sheep mingle while grazing, the cattle might butt or kick at these predators to drive them away.

"With social bonding, plus specially trained guard dogs that attack predators, we may be able to protect our sheep without building expensive fences," says animal physiologist Clarence V. Hulet.

Currently, electrified, multistrand fencing is required to keep sheep safe. Losses before the fence was installed were catastrophic. Hulet says, "Because sheep are so meek, coyotes and wild dogs find them easy marks on our ranges. We lost 44 percent of our sheep to coyotes the first year we had them on the Jornada Range."

Electric fences and guard dogs have cut losses to about 5 percent. But Hulet hopes that if cattle and sheep stay together while grazing, even fewer sheep will be killed and costly electric fencing can be eliminated.

In studies so far, animal scientist Dean M. Anderson has found the strongest bonding during grazing resulted from an initial penning of 45-day-old lambs with yearling heifers for 30 days. The two livestock species are now freely intermingling as they graze pastures on the Jornada Experimental Range.

Protection for sheep is not the only benefit from intermingling livestock, Anderson says. Cattle eat mainly grasses while sheep prefer leaves from some small shrubs and broadleaf plants such as deer's tongue and woolly paperflower. In general, the more variety of plants on a range, the greater the potential for increased production through multispecies grazing.

In the experimental pastures, the scientists added two sheep for every cow. This heavier stocking rate does not seem to be damaging the range.

Coexistence is nothing new in the animal kingdom. For millions of years, various animals shared feed in the same area. This type of grazing still exists today on the natural grassland ecosystem of the Serengeti Plain in the east African nations of Tanzania and Kenya. The ARS scientists are examining ways to extend this to modern, more efficient meat and wool production.

Plants "Hibernate" During Drought

Some range plants struggling to survive drought cope with the situation much as bears do with winter—they "hibernate."

The plants' respiration slows, they give off less carbon dioxide, shed small roots, and live off stored carbon and nitrogen.

Agricultural Research Service plant physiologist William B. Sisson says

The Jornada Experimental Range

In 1912, some 190,000 acres of semidesert rangeland was withdrawn from public lands to form the Jornada Experimental Range in southern New Mexico. Sprawling between the San Andres Mountains to the east and the Rio Grande Valley to the west, this research ranch is one-fourth as large as the state of Rhode Island.

Its name—a Spanish word meaning an arduous journey—arises from its arid climate. Since the Jornada was established 74 years ago, it has seen several severe droughts. The most recent, in 1951-57, is believed to be the worst in 350 years.

The Jornada is subdivided into 44 experimental pastures by 307 miles of 4-wire fence. The vegetation, soils, and climate are similar to those for some 90 million acres in the Southwest. While 1 acre of good pasture in the Midwest or South may grow enough forage to feed one cow all summer, the average acre on the Jornada only provides enough forage to feed one cow for 1 to 3 days.—**D.S.** ■

that plants, like bears, face disaster if conditions are too harsh or prolonged. They run out of stored nutrients and die.

Sisson is conducting fundamental research to discover why some plants are better equipped to survive prolonged droughts. He has developed ways to track how efficiently range plants absorb essential elements such as carbon and nitrogen during good times and ration them during bad.

He is now using these findings to evaluate range plants from other parts of the world that might be suited to the southwestern United States. Researchers at the Jornada Experimental Range have tested several hardy, new grasses that outproduce native grasses. One of these, Lehmann lovegrass from Africa, yields twice as much forage as native grasses.

Kleingrass, also from Africa, seems well adapted to the area and may be a candidate to replace native grasses lost during droughts. Sisson says Kleingrass continued to extract nitrogen from the soil even during a a 60-day drought. This range plant is now thriving in parts of Texas and at the Jornada.

"We hope to learn what it takes to make plants successful survivors in desert areas," Sisson says. "When we learn more, plant breeders and perhaps genetic engineers will be able to use this information to develop new varieties." These would not only be survivors, but would provide more palatable, nutritious feed for grazing livestock and wildlife and hold soil from wind and water erosion.—By **Dennis Senft, ARS.**

Scientists mentioned in this article are in USDA-ARS Range Management Research, New Mexico State University, P.O. Box 3JER, Las Cruces, NM 88003. ■

In his greenhouse, physiologist William Sisson studies water-use efficiency of Kleingrass and other range plants to determine their adaptability to the Southwest where the annual rainfall is 10 inches or less. (0586X585-8)

Battle Plans for National Assault on Aphids

Hunting on an alfalfa leaf, a sevenspotted lady beetle captures one of its favorite dinners—a pea aphid. (0678X780-17)

The U.S. Department of Agriculture is planning a national assault on crop-destroying aphids. Their soldiers—an army of hungry ladybugs.

These hardy European and Asian predators, sevenspotted lady beetles *(Coccinella septempunctata)*, are bigger cousins of American ladybugs. The operation is known by an abbreviated version of the beetle's name: C-7.

The battlegrounds will be mainly the fields and gardens of the West, since the beetles already have a good start in the East. The leadership for the battle goes to USDA's Animal and Plant Health Inspection Service, the agency charged with coordinating biological control of agricultural pests.

Aphids are small, soft-bodied pests that suck sap from host plants, killing them or stunting their growth. They attack a variety of crops, including wheat, rice, corn, beans, alfalfa, barley, oats, peas, potatoes, sugarbeets, fruits, and vegetables. Citrus groves to Easter lilies have been laid to waste from their feeding and the plant diseases they carry.

If conditions are right, aphid numbers can swiftly rise to unmanageable levels—theoretically, as many as 600 billion in 9 generations.

But the sevenspotted lady beetle is a biological match for aphids, according to Richard J. Dysart, an entomologist with the Agricultural Research Service's Beneficial Insects Research Laboratory in Newark, DE. "A single larva can eat 300 to 600 aphids before pupating into an adult. And a single adult can put away from 2,000 to 3,000 during its lifetime."

And when aphid numbers get low, this predator is versatile enough to switch to eating plant pollen and nectar, enabling it to stay on the scene, ready to do battle again.

Dysart says, "Because the beetle can adapt to a variety of crops in diverse environments in Europe, we hope it will thrive throughout much of the United States."

The adult is about three-eighths of an inch long, making it larger than most of the 475 species of American ladybugs. Easily recognizable, it has deep reddish wing covers that carry the seven black spots that give it its name. Its head region is black, except for a small amount of white behind each eye.

In the spring, hungry adults move from their winter sites—tucked away in clumps of grass—and start clearing aphids from crops. After gorging themselves, adult females begin laying yellow eggs in clusters of 10 to 30, glued to the underside of leaves or other vegetation. Eggs take 3 to 5 days to hatch into larvae in the southern states, longer in colder parts of the country.

One of the earliest biological control successes was in 1888, when U.S. Department of Agriculture researchers began shipping vedalia beetles to California and releasing them in citrus orchards. These pioneers saved the

APHIS insect production coordinator Mike Bryan (left), APHIS Plant Protection and Quarantine Officer Gerry Terensinski (right foreground), and ARS entomologist W. Louis Tedders mount nets on a truck for a sweep through fields of legumes to collect sevenspotted lady beetles. (0586X598-18A)

Plant residue and sevenspotted lady beetle larvae and adults collected in nets during a truck run through fields. (0586X598-35)

citrus crop from an overwhelming attack of cottony cushion scale insects and have kept the insects under control ever since.

Just as the vedalia controlled scale in its native Australia, the sevenspotted beetle has been valued in Europe and Asia since the late 1880's for its ability to control aphids.

Dysart says the ARS Beneficial Insects Research lab first tried the sevenspotted ladybug in the United States in 1958. The lab either released or provided insects for 111 intentional introductions between 1958 and 1983. However, there was no evidence of permanent colonies before June 1973, when specimens were collected from northern New Jersey. Since then, they have become established in the eastern United States, with significant colonies as far south as Georgia and as far west as Indiana.

The sevenspotted lady beetle has great potential for protecting U.S. crops from the ravages of aphids. In some areas, the ladybugs are exerting significant control over aphids—saving farmers and gardeners millions of dollars a year in production costs. In other known introductions, however, they seemed to thrive for a year or so then disappeared.

It isn't completely clear why new colonies disappeared. Sometimes the introductions were too small, as in the case of a 1958 release in Imperial County, CA, which involved only 25 beetles. In other cases, the releases may not have been well timed. The beetles do better when released in spring than in fall and better when released in the evening than in the morning. Some releases could have fallen victim to insecticides.

Most efforts to spread the beetles will focus on states west of the Mississippi River, where they have so far successfully colonized only one small area in Oklahoma, according to Gary Cunningham, the APHIS plant pest specialist in charge of biological control programs.

The beetles to be released will come from established colonies in the East, such as those at the ARS Southeastern Fruit and Tree Nut Research Laboratory in Byron, GA. One reason APHIS chose the Georgia lab is that the beetles were successfully established there by ARS in 1976 and their numbers have increased each year since.

The agency also chose Byron because there is room to grow large fields of legumes to attract pea aphids, a favorite food of sevenspotted lady beetles. Tom Burger, head of the APHIS Biological Control Laboratory in Niles, MI, and Mike Bryan, the lab's production coordinator, are working with W.L. Tedders at the Georgia lab to determine the best legume varieties for attracting the beetles, on irrigated and nonirrigated land. They have 14 plots on 25 acres at Byron, planted with varieties of crimson clover, hairy vetch, and arrowleaf clover.

Burger and Bryan are also trying to determine the plant varieties most suita-

ble for mass-collecting the beetles with mechanized equipment, such as four-wheel-drive vehicles with large nets attached. That's the way the Niles lab successfully collected alfalfa weevils in another APHIS biological control project. The vehicles will be driven through the legume fields in the hopes of sweeping beetles into the nets in large numbers. If this equipment proves unsuitable to collect lady beetles, other equipment will have to be used, perhaps a sort of large vacuum cleaner.

Tedders says the APHIS legume plots, planted near the end of 1985, have already attracted millions of sevenspotted beetles.

APHIS will release the predators at about 300 sites across the western two-thirds of the country and maybe at some sites in the East where the beetles might not be well established. Plans call for APHIS to release 4,000 of the predators at most sites and up to 20,000 at others.

As a guide on where to release, the agency will use a map of the United States, with grid lines drawn at 120-mile intervals. Releases will be made at many of the points of intersection—provided they are not in Death Valley or some other area not likely to be populated with aphids. They will also be released in areas known to have aphid problems, whether they are at the grid intersections or not. The exact number of sites will depend on the results of a survey.

APHIS plant protection inspectors will make the releases, working cooperatively with people from state departments of agriculture, the Extension Service, ARS, and university researchers. They will notify farmers and gardeners locally before distributing beetles.

"There is a lot of interest in improving and expanding the use of biological pest control to limit damage done by both insects and weeds," Cunningham says. "We are looking into all types of methods—including sterile-male release, pheromones, and diseases and parasites of pests—as alternatives to conventional pesticides."

This year, as part of a continued and expanding interest in biological control, APHIS enlarged the technical advisory group that selects the most promising projects. The group originally had representatives from APHIS, ARS, USDA's Cooperative State Research Service, the Extension Service, the U.S. Environmental Protection Agency, and the National Plant Board (a group of state plant pest specialists). Now the group also includes representatives from state experiment stations, USDA's Forest Service, and regional APHIS offices.

At a meeting earlier this year at the ARS lab in Delaware, the advisers recommended APHIS consider biological control projects against four other pests:

- Rush skeletonweed in the Pacific Northwest with a mite, a midge, and possibly a fungal rust.
- Leafy spurge, a weed found mainly in the northwestern quarter of the United States, using a defoliating moth and possibly other beneficial insects.
- Lygus bug, a pest of cotton and alfalfa, using a variety of parasites.
- European corn borer with an imported parasitic tachinid fly.

The sevenspotted lady beetle project is one of six ongoing APHIS biological control projects started in the past 4 years. The others are concerned with the following pests: alfalfa weevil, citrus whitefly, silverleaf nightshade, Colorado potato beetle, and diffuse and spotted knapweed.—By **Don Comis,** ARS, and **Max Heppner,** APHIS.

Richard J. Dysart is at the USDA-ARS Beneficial Insects Research Laboratory, 501 South Chapel Street, Newark, DE 19713. Gary Cunningham is at the USDA-APHIS Technology Analysis and Development Staff, 648 Federal Building, Hyattsville, MD 20782. ■

Mold-Eating Mold

Even if you could say *Sphaeronaemella helvellae,* it still doesn't sound very friendly. But this mold could wind up saving farmers millions of bushels of corn each year, says plant pathologist Nader G. Vakili.

Vakili, a researcher with the Agricultural Research Service in Ames, IA, happened on *S. helvellae* while he was studying the fungi that make cornstalks rot and fall over before harvest.

In this case, he was surprised to see one fungus growing on another rather than on the stalks. The strange fungus didn't look much different from the others at first, but Vakili could see through the microscope that it had invaded a stalk-rot fungus.

S. helvellae had spread throughout much of the damaging fungus' mycelium—the weblike filaments that grow into the host plant's tissues. The new fungus was even destroying the reproductive spores of its victim.

Vakili had chanced on a mold-eating mold.

Since that day 4 years ago, he has been working to find ways to use *S. helvellae*, and a half dozen other friendly fungi that he has located, to control certain cornstalk diseases.

Stalks weakened by molds are a fairly serious problem to corn farmers, says Vakili. His experience with more than 200 commercial corn varieties in 6 years of tests has been that stalk rot losses average 5.6 percent of the crop each year. On this basis, 1985 losses in Iowa—the leading corn-producing state—would have been around 95 million bushels.

Vakili believes that his collection of mold-eating fungi can be used to complement the disease resistance that plant breeders are striving for in commercial corn varieties.

Experiments have shown that some corn lines benefit more than others from treatment with mold-eating fungi, indicating that corn breeders should be able to develop corn lines that provide a favorable environment for the mold-eating fungi.

In one experiment to evaluate the mold-eating molds, Vakili treated seed corn of four corn lines with spores of five friendly fungi: *S. helvellae, Gliocladium roseum, Trichothecium*

Might Save Corn

Microscopy reveals the transparent, shadowy outline of the friendly fungus *Sphaeronaemella helvellae* parasitizing the spore-production structure in the harmful fungus *Helminthosporium carbonum* and preventing spore dispersion. (PN-7212)

roseum, an *Exobasidiellum* sp., and *Gonatobotrys simplex*.

Seeds were placed in a planting medium with several disease fungi: *Penicillium, Fusarium moniliforme* (causes one of the worst corn diseases, according to tests run by ARS plant pathologist Raymond L. Clark at Ames), *Rhizopus* sp., and *Cephalosporium acremonium*.

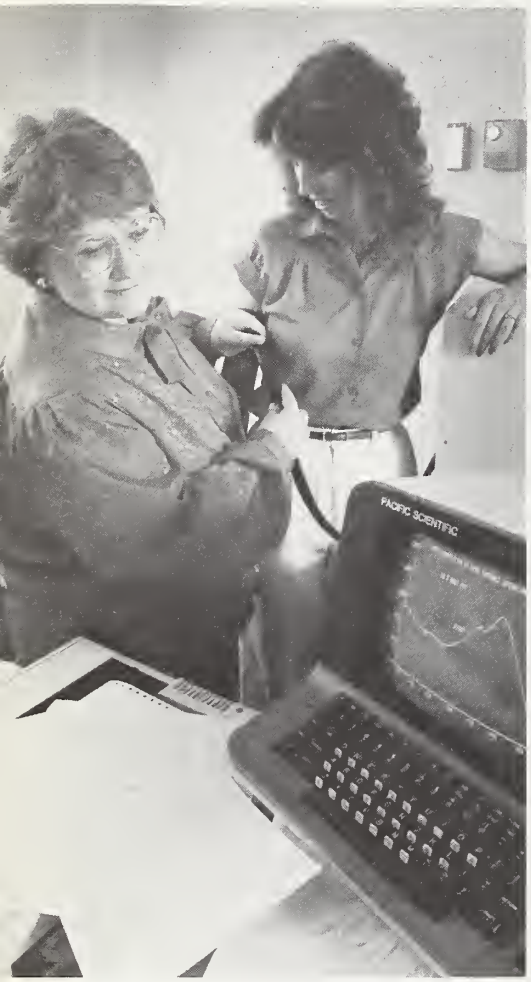
The germination rate was higher and root growth was greater with the protective spore treatment. Seedling vigor, as measured by weight of the roots, was significantly increased. In the germination tests, 97 percent of the kernels treated with *S. helvellae* germinated, compared with 88 percent of the untreated kernels. When analyzed for disease, kernels treated with *G. roseum* showed 6.6 percent diseased kernels; untreated kernels were 42 percent diseased. *G. roseum* practically eliminated *Penicillium* from all four of the corn lines it was tested on.

In addition to disease control, another advantage of using a fungus to control a fungus is safety, Vakili says. Seed corn is commonly treated with fungicides that are toxic to animals, so unneeded seed corn cannot be used and must be destroyed. If mold-eating fungi were used as a fungicide, unused seed corn could be safely fed to livestock.—By **Ray Pierce,** ARS.

Nader G. Vakili is in USDA-ARS Cereal and Soybean Improvement Research, Rm. 411 Bessey Hall, Iowa State University, Ames, IA 50011. ■

Plant pathologist Nader Vakili observes dual cultures of *S. helvellae* and its host, *H. carbonum*, on agar medium. (108X1276-27A)

The Light Way To Measure Body Fat



Using a computer-assisted near-infrared spectrophotometer, chemist Joan Conway measures body fat content of biological lab technician Janice Collins. (0586X601-28)

A touch of a wand to your biceps can give you a computer printout showing your body fat percentage.

This high-tech fat-measuring technique is being tested at the Human Nutrition Research Center in Beltsville, MD. It uses short wavelengths of harmless, infrared light to measure body fat at key spots on the body, says Joan M. Conway, a chemist at the Center. Conway is collaborating with ARS engineer Karl H. Norris, who invented the infrared interactance (IRI) technology.

IRI makes use of the principle that fat, water, protein, and other body components absorb different parts of the near-infrared spectrum. When near-infrared light is beamed through the skin—one wavelength at a time—each wavelength is either absorbed or reflected depending on the type of tissue it hits.

When further refined, IRI could lead to commercial machines that are portable and easy to use. Conway is also comparing infrared interactance with other methods for measuring body fat.

According to Conway, machines based on IRI "would be ideal for doctors' offices and hospitals to help determine if patients are losing or gaining fat on prescribed diets."

She expects that college athletic departments and professional sports teams would be among the first users.

IRI's results will have to be validated through many more tests with humans under controlled experimental conditions, Conway says, but "it has tremendous potential for simplifying the measurement of body fat."

A portable body-fat machine "would make it easier for researchers to do large-scale surveys on body composition," she says. The results could then be used in conjunction with information about the surveyed population's eating habits to refine calorie requirements. Currently, the most common method for assessing body fat is to pinch the skin and measure its thickness at several spots on the body, but the procedure leaves a lot of room for error.

Tests on 155 men and women ranging in age from 20 to 65 have shown IRI to be faster, easier, and more accurate than using skinfold measurements, Conway says.

IRI estimates of total body fat compared favorably with estimates obtained by the deuterium oxide, underwater weighing, and total body impedance methods. Underwater weighing and deuterium oxide are the current "gold and silver" standards for body composition studies, she says, but both have limitations. They are time-consuming, must be done in a laboratory, and require subjects to give blood samples or to be totally submerged in a water tank.

ARS engineer Norris discovered the principle behind IRI more than 20 years ago and has used it to develop prototypes for a number of commercial instruments. These instruments are now being used in the agricultural industry to assess the fat content of ground meat, the oil content of avocadoes, and the nutrient content of grains and forages. With Norris' help, Conway is trying to adapt the technology to people.

For the human studies, the two scientists borrowed an instrument based on Norris' research from the Neotec Instruments Division of Pacific Scientific. The instrument—a computerized spectrophotometer—was programmed to read the amounts of fat and water, because the two are mutually exclusive. When the fat content increases, the water content decreases proportionately.

To determine total body fat, Conway measures five of the sites on the body used in the skinfold method. The five sites are on the front of the upper arm at the bicep, on the back of the upper arm at the tricep, on the back just below the shoulder blade, above the hip, and on the front of the thigh.

However, Conway says, her results show that the bicep measurement alone may give a good estimate of body fat.

Conway and Norris will soon be testing a simpler instrument that scans only a few selected wavelengths instead of the 400 used in these studies. It would be portable, less expensive to manufacture than the computerized spectrophotometer, and easier to use.

If the team is successful, says Conway, "commercial body-fat machines could even wind up in drug stores and supermarkets like the blood pressure machines you see today."—By **Judy McBride,** ARS.

Joan M. Conway is at the USDA-ARS Beltsville Human Nutrition Research Center, Rm. 318, Bldg. 308, BARC-East, Beltsville, MD 20705. Karl H. Norris is at the USDA-ARS Instrumentation Research Laboratory, Bldg. 002, BARC-West, Beltsville, MD 20705. ■

New Vitamin C Test More Accurate

Vitamin C can be measured in blood more accurately than ever before with a new test developed by Agricultural Research Service scientists.

The test distinguishes vitamin C or ascorbic acid from the closely related compound isoascorbic acid that is used as a food additive, says Stanley T. Omaye, a nutritionist at the agency's Western Human Nutrition Research Center in San Francisco.

"Until now, the most commonly used methods to measure vitamin C didn't distinguish between the two compounds," says Omaye. "This means that results from these earlier tests—which are used by physicians, nutritionists, and other health-care professionals—could be misleading because isoascorbic acid doesn't have the same benefits as vitamin C."

The test can be used to detect vitamin C deficiency and to let doctors know if patients recovering from burns or surgery are getting enough vitamin C. "If the test is routinely used to monitor vitamin C, it can identify small but important fluctuations in a patient's vitamin C level long before an actual deficiency occurs," Omaye says.

According to Omaye, leading candidates for the deficiency in this country include teenagers who go on fad diets or elderly patients who fail to eat enough fruits and vegetables rich in vitamin C.

Vitamin C helps heal wounds and keep teeth, gums, bones, and joints healthy. Good sources are citrus fruits, strawberries, cantaloups, leafy green vegetables, peppers, broccoli, and cauliflower.

Vitamin C and isoascorbic acid can be identified by other tests, but they are much slower and are not as sensitive as the new procedure. These tests also fail to detect very small amounts of the vitamin and require more blood for the sample.

Omaye, along with Mark A. Kutnink, James H. Skala, and Howerde E. Sauberlich at the Center, developed the test. Sauberlich is now at the University of Alabama at Birmingham.

The test uses what may be a unique combination of a superior preservative and another chemical that makes separation of the compounds possible. The preservative is needed because vitamin C is highly unstable and decomposes rapidly, making it difficult to measure accurately.

Omaye says food processors can use the new test to check vitamin C levels in their products against the levels stated on the product labels, or they can use it to check levels of isoascorbic acid.—By **Marcia Wood,** ARS.

Stanley T. Omaye is at the USDA-ARS Western Human Nutrition Research Center, P.O. Box 29997, Presidio of San Francisco, CA 94129. ■

Breathalyzer for Alcoholic Peanuts

A peanut containing too much alcohol can be declared "drunk" by a new test that Agricultural Research Service scientists have developed.

If peanuts are exposed to severe cold or heat before they are cured, they produce alcohol and related compounds that give them a bitter flavor, according to Harold E. Pattee, an ARS chemist in Raleigh, NC.

"It's sort of a breathalyzer test," says Pattee, who developed the testing concept. "The meter tells us the level of alcohol and related compounds so that the bad-tasting nuts can be separated from the good-tasting ones. Those with off-flavor can still be used to make oil and other products."

The meter is being tested in Georgia, Texas, and North Carolina, according to Pattee and James W. Dickens, an ARS agricultural engineer who designed the meter. Georgia is the biggest peanut-producer by far, with Alabama running a distant second and Texas and North Carolina following closely behind. Testing will be expanded in the fall when this year's peanut crop is sold.

If it proves successful, Dickens says, the meter may move into commercial use. "A meter will cost about $500, which is cheaper and more practical than potential chemical tests that are still under development."

In the test, about 3 ounces of peanuts are put in a blender and ground up for 10 seconds. A special sensor is put in a hole at the top of the blender for 4 to 5 seconds. The sensor detects alcohol vapor, just as a smoke detector measures smoke.

Professional taste panels judge peanuts with a meter reading of 360 or more to be unacceptable. At that high a level, the alcohol and related compounds vaporizing from the sample are equal to that coming from a solution of 0.021 percent ethyl alcohol.

The peanuts with the lowest readings registered 231—equivalent to 0.002 percent ethyl alcohol and water.

Alcohol and other related compounds are formed in freshly harvested nuts when they are subjected to freezing temperatures, or when they are heated beyond 95 °F. Extreme temperatures upset their respiration, causing them to produce alcohol.

Cold can be a problem after peanuts are dug but before they are harvested. Often farmers dig them and leave them in the fields for 5 to 7 days before picking from the vines, allowing them to partially dry in the fields. But during that period, they can be damaged by frost or freezing, despite a farmer's best efforts to prevent it.

Heat can be a problem when nuts are cured to remove moisture. Peanuts contain from 40 to 50 percent moisture when dug, and field-drying lowers that to about 20 percent. Then they are usually cured to about 8 percent moisture by forcing heated air through them. If the heated air is not carefully controlled, damage occurs.—By **Sean Adams,** ARS.

Harold E. Pattee is in USDA-ARS Market Quality and Handling Research, North Carolina State University, P.O. Box 7625, Raleigh, NC 27695 ■

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PATENTS

Natural Lure for Grapevine Pest

A sex attractant that's given off by a destructive insect of California vineyards—the grapeleaf skeletonizer—has been isolated, synthesized, and patented. The attractant, a pheromone, lures male moths to special vineyard traps used to monitor the size and location of the infestation. This information is used when deciding on pesticide applications. The traps are more economical and faster than the more tedious vineyard inspections for moths.They might someday also be used on a larger scale to reduce the population of skeletonizers if these insects become resistant to currently used insecticides.

Female grapeleaf skeletonizer moths emit the attractant, known as *sec*-butyl *(Z)*-7-tetradecenoate, to lure the bluish-black male moths during mating season. Shortly after mating, the female lays eggs that later develop into voracious, leaf-eating larvae. The wormlike larvae kill the leaves of the grapevines and leave the vine unable to produce chlorophyll. The white, lacelike, skeletal look of the leaves is unmistakable evidence of skeletonizer damage. Hairs on the larvae can sting and leave a welt on the skin of grape pickers or others who come in contact with the insect.

For technical information, contact Edwin L. Soderstrom, USDA-ARS Horticultural Crops Research Laboratory, 2021 S. Peach Avenue, Fresno, CA 93747. *Patent No. 4,563,348,* "*Sec-butyl* (Z)-*7-tetradecenoate and Its Use as a Sex Attractant for the Grapeleaf Skeletonizer.*" ■

Laundering Soiled Plants

Agronomists studying plant propagation are often faced with the tedious task of separating roots, seeds, and other plant tissue from soil samples. Previous filtering devices could only wash small amounts of soil at a time, were laborious to operate, and did not work effectively with clay soils. Now, a new apparatus has been developed which can rapidly and thoroughly separate plant tissue from soil and accommodate a large volume of material at one time.

The device consists of a wash tank, a rotating offset shaft and drive assembly, canisters to hold the soil samples, and a canister-support cradle. The tank is filled with water, the machine is switched on, and the shaft rotates to submerge each canister and agitate it gently. Perforations in the canisters allow solution and soil to move freely but keep the plant tissue intact.

The new washer could also be used for cleaning archaeological artifacts, precious stones, and other items which are heavily soiled. If necessary, a mild detergent may be added to the wash tank.

For technical information, contact William W. Donald, research agronomist, USDA-ARS Metabolism and Radiation Research Laboratory, P.O. Box 5674, State University Station, Fargo, ND 58105. *Patent Application Serial No. 06/825,004, "Washer for Plant Roots and Other Articles."* ■

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Copies of existing patents may be purchased from the Commissioner of Patents and Trademarks, U.S. Patent and Trademark Office, Washington, DC 20231. Copies of pending patents may be purchased from National Technical Information Service, U.S. Department of Commerce, 5285 Port Royal Road, Springfield, VA 22161. ■